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REVIEW ARTICLE

Surgical morbidity in obese children

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Summary In recent years, there has been a worldwide increase in childhood obesity. At present, pediatric surgeons manage a greater number of pediatric patients who are significantly overweight. Little data exist regarding the surgical challenges of obese children. This review study was designed to examine the relationship of obesity to surgical comorbidities, postoperative complications, and perioperative outcome in children, and to pediatric trauma. Obesity seems to be an independent risk factor in surgical-related pediatric morbidity and should be considered an important variable when looking at surgical outcomes in the pediatric population. Identification by and awareness among pediatric surgeons, of increased risk factors for peri/postoperative complications, will be crucial in optimizing the hospital stay and outcome of these children.

1. Introduction

The terms "at risk of becoming overweight", "being overweight", and "being obese" have been used to refer to the increasing weight problem in children.[1] Obesity specifically refers to the condition of having excess body fat, but in children and adolescents physiologic increases in adiposity/height/weight during growth are expected.[1] Growth charts that are typically used to define obesity are age and gender specific.[2] Overweight is defined as a body mass index (BMI) greater than the 85th percentile for age and gender (i.e., a BMI in young adults of approximately 25 kg/m^2), and pediatric obesity as a BMI greater than the 95th percentile for age and gender (i.e., a BMI of approximately 30 kg/m^2 in young adults).[1,3–5] Obesity is now considered the most common nutritional disorder of children and adolescents in developed world,[6] and constitutes a public health crisis[7] that affects physical and psychological growth and development. Pediatric obesity is a multifaceted disease with serious immediate-, intermediate-, and long-term consequences, and an increased risk for morbidity and mortality,[6,8–10] having also psychosocial and economic effects.[11–16] Obesity is an independent risk factor for perioperative morbidity, and morbid obesity is a risk factor for mortality.[17] Health consequences of childhood obesity, which are

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recognized at a younger age, are broader in scope, greater in prevalence, and more severe at a given time point in disease progression than previously thought.[18–20]

2. Special perioperative considerations in obese children

A lot of obesity-caused pathological comorbid conditions, such as insulin resistance, hyperlipidemia, and hypertension, may be silent, and it is incumbent upon the pediatric surgeon to screen for these disorders prior to planning any elective surgery in obese children,[21] because these conditions affect the recovery of operated children. Obese children undergoing any surgical procedure have unique physiologic and anatomic issues that must be understood to provide optimal care.[21]

Meticulous positioning and padding of a morbidly obese patient undergoing a surgical procedure are critical to prevent pressure necrosis, rhabdomyolysis, and peripheral nerve damage.[22]

Airway management of an obese child poses specific challenges to the anesthesiologist because many of the normal anatomic landmarks are difficult to visualize and control of the airway may be problematic.[23] Perioperative respiratory events seem more frequent in overweight and obese children.[24,25] Obese children have a higher incidence of multiple attempts at laryngoscopy,[26] airway obstruction,[27] difficult mask ventilation, and intraoperative desaturation.[26,27] They have a significantly higher prevalence of comorbidities than non-obese children, including asthma and sleep apnea.[26]

Monitoring with pulse oximetry may be preventively indicated after surgery, because obesity is associated with obstructive airway disease (from upper airway collapse or obstruction),[5] and is essential in the case which the patient has a history of sleep disorders or symptoms consistent with a sleep disorder.[21]

Postoperatively, obese patients are at an increased risk for atelectasis,[21] because obesity may be associated with restrictive pulmonary disease (from restriction of chest wall and diaphragm movement).[5]

Obesity is a known risk factor for the development of deep venous thrombosis (DVT) and pulmonary embolism (PE) after surgery in adults. All adolescents undergoing bariatric surgery receive prophylaxis for DVT and PE (low-molecular-weight heparin and intermittent sequential compression devices).[28] More data are needed before definitive recommendations can be made, but obese adolescents undergoing other surgical procedures, especially major ones, may also benefit from DVT prophylaxis.[21] In addition, obese children are at a high risk for venous stasis disease[1] and coagulopathy (hypercoagulable state).[29,30] Also, mean platelet volume is significantly higher in obese adolescents.[31]

Antibiotic and other drug dosing are complicated by obesity due to the body composition and relatively high volume of distribution.[32] Therefore, in severely obese adolescents, standard dosing of cephalosporins may be inadequate, and aminoglycoside dosing may require the use of special formulas or help from a clinical pharmacologist.[32,33]

3. Postoperative surgical complications

Obesity has a clear, but not yet precisely defined, effect on the immune response through a variety of immune mediators, which leads to susceptibility to infections.[34] It is a risk factor for nosocomial infection, particularly surgical site infection,[1,34,35] leading to prolonged hospitalization and frequent rehospitalization. The incidence of surgical wound infections is directly related to tissue perfusion and oxygenation.[36,37] Tissue oxygen tension was found to be less in morbidly obese patients than in lean patients undergoing open abdominal surgery, which might contribute to the observed higher risk of wound infection rate in obese patients.[38,39] Wound dehiscence and anastomotic leaks seem to be more common in obese patients.[40,41] Obesity and wound infections are related pathogenetic factors of incisional hernias.[42] Also, recurrence after incisional hernia repair is more likely in obese patients.[43]

Wounds in children are generally treated according to the principles of adult wound care.[44] More subcutaneous adipose tissue result in an increased potential for contaminated dead space. Host susceptibility to infection can be predicted by morbid obesity in children too.[45] A study of surgical wound infections in the pediatric surgical population showed that wound infections are more related to factors at the operation (contamination at the time of operation, duration of procedure).[46] Childhood obesity is associated with higher median operative time,[47] increased risk of postoperative infections,[47,48] and longer hospital stays.[47]

4. Laparoscopy in obese children

In spite of laparoscopic procedures being considerably more complicated in obese patients[49] (and with more technical difficulties), laparoscopic abdominal surgery is relatively safe, even in morbidly obese patients,[50,51] and is associated with less tissue injury than open surgery.[52]

Morbid obesity significantly decreases respiratory system compliance and increases inspiratory resistance.[49] Increased body weight, not-altered mechanics of breathing, increased intra-abdominal pressure, and reversed Trendelenburg position are associated with worse PaO_2 during laparoscopy.[49]

Laparoscopic appendectomy should be the procedure of choice for the treatment of acute appendicitis in the morbidly obese population, because it is associated with a shorter length of stay, lower morbidity, and lower costs.[53] Despite the known surgical challenges with overweight patients, laparoscopic cholecystectomy is a safe and equally beneficial procedure in overweight children.[54]

5. Surgical diseases in obese children

Nonalcoholic steatohepatitis is recognized as a common cause of chronic liver disease in children, frequently associated with obesity.[55–57] It has been suggested that obesity-related pediatric nonalcoholic steatohepatitis may become a major cause of hepatic failure, cirrhosis, and a leading indication for liver transplantation in decades to come.[57–59]

Biliary disease is also common in obese children,[21,60] with 8–33% of all gallstones seen in childhood being related to obesity.[6] Therefore, obesity appears to be a risk factor for the development of gallstones in childhood and adolescence.[61]

Obese children with metabolic syndrome have high lipidemic profile, most often manifested by elevated low-density lipoprotein cholesterol, elevated triglycerides, and decreased high-density lipoprotein cholesterol.[8] These metabolic disorders may be associated with acute or chronic relapsing pancreatitis in children.[62]

There is a growing body of evidence illustrating the association between increasing BMI and gastroesophageal reflux disease (GERD) in adults.[63–66] Obesity and overweight are independent risk factors for GERD and endoscopy-proven esophageal erosions.[67] Adults with chronic GERD are at risk of developing associated complications, such as erosive esophagitis,[68] Barrett's esophagus,[69] and adenocarcinoma of the esophagus.[70] Similar data in the pediatric literature are sparse. A study published by Størdal et al[71] in 2006 demonstrated an association between increasing BMI and GERD in children aged 7–16 years, as reported by symptoms or pH-monitoring abnormalities, but the prevalence of reflux esophagitis is not greater in children who are overweight or obese than in those with normal weight.[72,73] The association between childhood obesity and GERD may have important implications for their future risk of GERD-associated diseases, such as esophageal adenocarcinoma.[74]

Diagnosis of acute appendicitis in very obese children can sometimes be difficult and challenging.[75] Obese children are more likely to have abdominal pain, higher intensity and higher frequency of pain, school absenteeism, and disruption of daily activities.[76] Obesity is associated with poor outcome and disability at long-term follow-up in children with abdominal pain-related functional gastrointestinal disorders.[76] The incidence of histologically normal appendix and the false-positive rate of ultrasound in very obese children are significantly higher than in nonobese children undergoing emergency appendectomy.[75] Also, the specificity and sensitivity of ultrasound are significantly lower in very obese children compared to non-obese children.[75]

Historically, 0.1% of children undergoing laparotomy for suspected appendicitis have primary omental torsion (POT).[77] Although it is a rare cause of abdominal pain in children, it has no distinguishing features to separate it from other causes of a surgical abdomen.[77] Problematically, its clinical presentation can closely mimic that of acute appendicitis.[78,79] Obesity seems to be a major risk factor in the development of POT in children.[80] POT should be considered in the differential diagnosis when assessing abdominal pain in obese children, especially those who are not ill appearing.[80] A high index of suspicion and an abdominal CT scan help make an early preoperative diagnosis.[80] Increased fat deposit in obese children outstrips the blood supply to the developing omentum, leading to relative ischemia as the inciting event, increased omental weight leading to torsion, or traction to the most distal parts of the omentum.[80] Childhood obesity predisposes the omentum to twist around its long axis, leading to vascular compromise, infarction, and gangrene.[81]

Obese children are more susceptible to intertriginous soft-tissue infections,[1] as well to develop serious complications of these common infections,[34] such as abscess formation. Pilonidal cyst and sinus of coccyx seem to be more common in obese teenagers. Obese patients are more likely to experience an infection (abscess and fistulas formation) and a recurrence of cyst too.[82]

6. Obesity in pediatric urology

Diet and personality may be part of the etiology for some urological disorders, and BMI in children seems to be related to a variety of urological diagnoses.[83] An increased weight-for-length percentile in male infants before and after circumcision may be associated with penile adhesions, and/or hidden penis.[84] Children with urinary infection and incontinence have the highest BMI percentile.[85] There is a high rate of obesity in children with dysfunctional voiding, especially nocturnal enuresis.[85] Children with a normal BMI have a significantly higher rate of completing a urinary diary and higher efficacy of treatment, compared to those with a high BMI.[85]

7. Trauma in obese children

Airway and breathing management of a seriously injured obese child poses specific challenges. Normal anatomic landmarks are difficult to visualize, and control of the airway may be problematic.[23] Obese children have a higher incidence of multiple attempts at laryngoscopy,[26] airway obstruction,[27] and difficult mask ventilation.[26,27] Also, obesity may be associated with obstructive airway disease and/or restrictive pulmonary disease.[5]

Obesity is an independent predictor of adult mortality following severe blunt trauma.[86] Injured obese children and adolescents have more complications and require longer intensive care unit stays.[87] Obese children are more susceptible to bone fractures.[88,89] Obesity and impaired bone health may contribute to pediatric forearm fracture risk associated with minor trauma.[90] In pediatric trauma patients, obesity may be a risk factor for sustaining an extremity fracture requiring operative intervention and having a higher risk for certain complications (i.e., DVT and decubitus ulcers).[91] Obese children and adolescents have a lower incidence of severe head and intra-abdominal injuries.[87,91] Obese patients are more likely to suffer a burn of a high-risk anatomic area, and their median length of hospital stay is significantly higher than nonobese patients.[92]

8. Conclusions

Management of obese children and adolescents, as surgical patients, is associated with increased incidence of comorbidities, and can sometimes be difficult and challenging. Identification by and awareness among pediatric surgeons, of increased risk factors for peri/postoperative complications, will be crucial in optimizing the hospital stay and outcome of these children.

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